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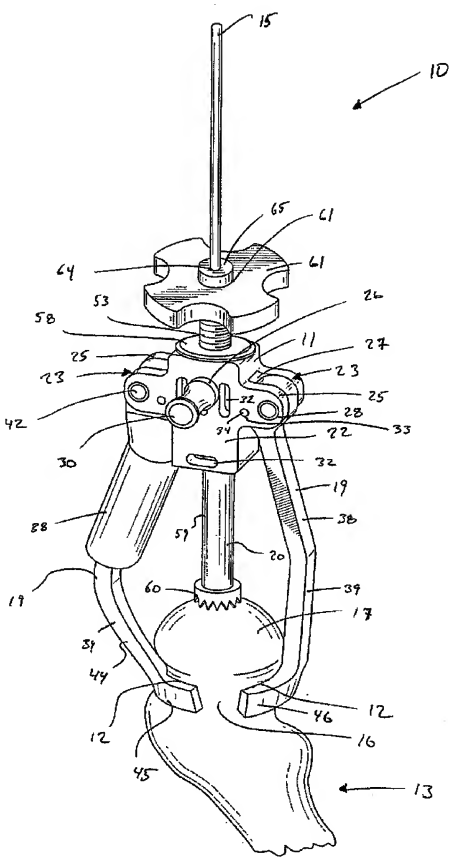
(54) Title: GUIDE CLAMP FOR GUIDING PLACEMENT OF A GUIDE WIRE IN A FEMUR



(57) Abstract: A guide clamp (10) for clamping a femur and guiding placement of a guide wire relative to the femur. The guide clamp includes a body (11) supporting a pair of clamping surfaces (12) at the end of a pair of clamping arms (19) that are spring-biased to move with respect to each other into a closed position to grip the femur. Defined by the body is a guide opening (14) that guides insertion of the guide pin (15) once the femur has been gripped. One of the clamping arms (19) of the guide clamp may have proximal and distal portions that are slidably adjustable with respect to each other to allow a controlled repositioning of the guide opening with respect to the femur. The guide clamp may also include an engagement member (20) which is supported by the body of the clamp and is capable of advancing into abutting contact with the head of the femur.

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GUIDE CLAMP FOR GUIDING PLACEMENT OF A GUIDE WIRE IN A FEMUR

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims priority to United States Provisional Patent Application Serial No. 60/523,799, filed November 20, 2003, which is pending.

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention is related to the use of guides for placement of guide wires in orthopedic surgery, and more particularly to the use of a guide clamp for placement of a guide wire during femoral head resurfacing surgery.

Description of Related Art

When severe hip joint problems are encountered, it is sometimes necessary to replace a portion of the hip joint; either the ball or the socket or both. One generally used hip joint replacement technique involved removal of a head and neck of the femur, and the insertion of a long angled and tapered metal prosthesis into the central "intramedulary" canal at the open upper end of the main straight portion of the femur. This femoral prosthesis typically had a relatively small metal ball at its upper end which mated with a small plastic socket mounted on the hip side of the joint. However, this "total" hip replacement technique was drastic, involving complete removal of the head and neck of the femur, and made any subsequent hip joint problems difficult to handle.

U.S. Patent No. 4,123,806 to Amstutz, et al., discloses an early femoral prosthesis having a cobalt-chromium-molybdenum metallic shell of generally hemispherical shape. This femoral prosthesis is designed on the principle of removing all non-viable femoral head bone, but also preserving as much of the head and neck as possible.

In a more recent development, U.S. Patent No. 6,156,069 to Amstutz ("the '069 patent"), which is commonly assigned and hereby incorporated herein by

reference, discloses a metal-to-metal surface hip joint replacement. As shown in Figures 1-3 of the '069 patent, the metal-to-metal replacement includes a metallic (e.g. cobalt-chrome alloy) femoral prosthesis **22** and an acetabular prosthesis **40** also constructed of a metal material. Notably, Figure 1 of the '069 patent shows that placement of the femoral prosthesis requires shaping of the femoral head **30** to fit a stem **24** and internal geometry of the femoral prosthesis. Shaping of the femoral head requires the use of various cutting and drilling tools. Accurate completion of such shaping procedures is aided by the accurate placement of a Steinman pin or guide wire **74** which guides the cutting and drilling tools. The '069 patent discloses what has become commonly known as femoral head resurfacing.

A clamp **62** is used to facilitate centering and placement of the guide wire, as shown in Figure 9 of the '069 patent. The clamp includes a pair of jaws **64** that are supported by support member **68** and at pivot points **66** that allow pivotal rotation of the jaws with respect to the support member. Such rotation allows the jaws to engage the neck **32** of the femur **28**. The jaws are advanced and retracted by rotation of a handle **70** which advances a threaded actuator **76** through the body and moves a camming surface **72** attached thereto. The camming surface, in turn, drives opening and closure of the jaws about the neck. After the clamp is secured, the pin or guide wire is inserted into, and advanced through, collinear guide openings defined in the handle and threaded actuator until hitting an entry point **78** on the femoral head **30**. Advantageously, the ability of the clamp to engage and hold the guide openings in a fixed position relative to the femur promotes the accurate insertion of the guide wire or pin.

Despite the advantages of the clamp disclosed by the '069 patent, further improvements in the adjustability of positioning of pins and guide wires to improve the accurate placement of femoral prostheses are always desirable. It would be advantageous, therefore, to have a clamp and method with improved options to easily and accurately place a guide wire or pin which is subsequently used to guide femoral head resurfacing.

BRIEF SUMMARY OF THE INVENTION

The present invention addresses the above needs and achieves other advantages by providing a guide clamp for clamping a femur and guiding placement of a guide wire relative to the femur

It is an object of the invention to provide a guide clamp capable of one-handed operation.

It is an object of the invention to provide a guide clamp that provides for the more accurate centering of guide pins in, for example, the femoral head.

These and other objects of the invention are achieved by a guide clamp for clamping of a femur having a head and a neck, and guiding placement of a guide wire relative to the femur, the guide clamp comprising: at least two clamping surfaces configured to move between an open position and a closed position, wherein the clamping surfaces are sufficiently spaced apart in the open position to allow insertion of the femur therebetween and wherein the clamping surfaces generally oppose each other and are sufficiently close together in the closed position to firmly hold the femur therebetween; a body supporting the clamping surfaces and configured to allow movement of the clamping surfaces relative to each other, the body defining a guide opening configured to receive and allow passage of the guide wire therethrough to the femur; and a biasing assembly configured to bias the clamping surfaces into the closed position about the femur wherein the clamping surfaces secure the body relative to the femur so that the guide wire is secured relative to the femur when extending through the guide opening defined by the body.

These and other objects of the invention are achieved by a guide clamp for clamping of a femur and guiding placement of a guide wire relative to the femur, the guide clamp comprising: at least two clamping surfaces configured to move between an open position and a closed position, wherein the clamping surfaces are sufficiently spaced apart in the open position to allow insertion of the femur therebetween and wherein the clamping surfaces generally oppose each other and are sufficiently close together in the closed position to firmly hold the femur therebetween; a body supporting the clamping surfaces and configured to allow movement of the clamping surfaces relative to each other, the body defining a guide opening configured to receive and allow passage of the guide wire therethrough to the femur; and an engagement member supported by the body and which is configured to extend

therefrom into abutting contact with the head of the femur when the contact surfaces are in the closed position and the clamping surfaces secure the femur.

Furthermore, it is an object of the invention to provide a method of using the guide.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S)

Having thus described the invention in general terms, reference will now be made to the accompanying drawings, which are not necessarily drawn to scale, and wherein:

Figure 1 is a perspective view of a guide clamp of one embodiment of the present invention secured to a femur;

Figure 1A is a perspective view of a guide clamp of one embodiment of the present invention secured in a preferred orientation on a femur.

Figure 2 is a side elevation view of the guide clamp of Figure 1;

Figure 3 is a front elevation view of the guide clamp of Figure 1;

Figure 4 is a plan view of a body of the guide clamp of Figure 1;

Figure 5 is a side elevation view of a body of the guide clamp of Figure 1;

Figure 6 is another side elevation view of a body of the guide clamp of Figure 1;

Figure 7 is perspective view of a guide pin being used to guide resurfacing of a femoral head, said guide pin having been placed by the guide clamp of Figure 1;

Figure 8 is a side elevation view of a clamping arm of the guide clamp of Figure 1;

Figure 9 is a side elevation view of a proximal portion of another clamping arm of the guide clamp of Figure 1;

Figure 10 is a side elevation view of a distal portion of the clamping arm of the guide clamp of Figure 1;

Figure 11 is another side elevation view of the distal clamping arm portion of Figure 10;

Figure 12 is a plan view of the distal clamping arm portion of Figure 10;

Figure 13 is another side elevation view of the proximal portion of Figure 9;

Figure 14 is a cross-sectional view of the guide clamp of Figure 1;

Figure 15 is a side elevation view of a rack member of the guide clamp of Figure 1;

Figure 16 is a cross-sectional view of a knob retaining cap of the guide clamp of Figure 1;

Figure 17 is a cross-sectional view of a locking knob of the guide clamp of Figure 1;

Figure 18 is a side elevation view of a primary guide shaft of the guide clamp of Figure 1; and

Figure 19 is a side elevation view of a textured tip of the guide clamp of Figure 1.

DETAILED DESCRIPTION OF THE INVENTION

The present invention now will be described more fully hereinafter with reference to the accompanying drawings, in which some, but not all embodiments of the invention are shown. Indeed, this invention may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will satisfy applicable legal requirements. Like numbers refer to like elements throughout.

A guide clamp **10** of one embodiment of the present invention includes a body **11** movably supporting two or more clamping surfaces **12** that can be moved from an open (separated) position that allows insertion of a femur **13** (and more specifically the femoral head **17**) therebetween and a closed position wherein the clamping surfaces are firmly secured about the femur (e.g., around a neck **16** of the femur), as shown in Figures 1-3. Defined in the body **11** is a guide opening **14** that allows passage of a primary guide shaft **59**. In turn, the primary guide shaft **59** defines a guide opening **64** that allows direct passage of a Steinmann pin or guide wire **15** directly therethrough to intersect a head **17** of the femur **13**. The term "guide opening" as used herein describes any opening that directly (e.g., guide opening **64**), or indirectly (e.g., guide opening **14** which houses the guide shaft **59** defining directly guiding opening **64**), supports the guide wire **15**.

When firmly secured about the femur, the guide clamp **10** preferably aligns guide openings **14, 64** with the central axis of the femoral head **17** and the clamping surfaces grip the femur sufficiently tightly to allow steady guidance of the guide wire

as its extends to the femur **13**. Generally, the guide clamp **10** can further include one or more alternative or combined aspects of the invention, such as: the use of a biasing assembly **18** (Fig. 14) and/or use of an engagement member **20**.

Referring in particular to Figure 1, the femur of the patient is shown disassociated from the acetabular socket (not shown) and includes the femoral head **17** separated by the femoral neck **16** from the remaining portions of the femur **13**. Generally, as is typical in most humans, the femoral head **17** has a semi-spherical shape that at its base is supported by the neck **16** which is roughly cylindrical with a narrowing diameter as it extends to its attachment to the rest of the femur **13**. Although the guide clamp **10** of the present invention is preferably used to place the guide wire **15** in the femoral head **17**, the guide clamp could also be used to place the guide wire in other parts of the femur, or even other bones, such as the tibia or humerus, where the guide wire needs to be centered along the axis of a ball and socket joint.

Anatomical terminology is used herein, and in particular the terms "proximal" and "distal," are used herein to refer to guide clamp **10** as if it were attached to the femur **13** in the anatomical position with a top of the guide clamp (with respect to its orientation in Figure 1) being proximal and the bottom of the guide clamp extending distally to attach to the femoral neck **16**. However, these directional references are used for clarity and convenience and it should be recognized that other orientations are also possible for the guide clamp **10** and still fall within the purview of the present invention.

The body **11** of the illustrated guide clamp **10** may be constructed of a unitary piece of material having a main portion **22**, a pair of clevises **23** and a pair of finger grip mounts **26**, as shown in Figures 4-6. The clevises **23** are spaced apart on opposite lateral sides of the main portion **22**. Each of the clevises **23** includes a pair of clevis members **25** extending laterally from the lateral sides of the main portion **22**.

The clevis members **25** of each pair are spaced from each other and define a clevis slot **27** therebetween. Each of the clevis members **25** defines a cylindrical opening **28**. The cylindrical opening of each of the clevis members **25** is concentrically aligned with the cylindrical opening **28** of the adjacent one of the clevis members. This arrangement allows each adjacent pair of the cylindrical openings to receive one of a pair of arm shafts **42** so as to form a rotatable mount for supporting

one of a pair of clamping arms **19** which, as described below, serve as supports for the clamping surfaces **12**.

The finger grip mounts **26** are positioned on the remaining opposite sides of the main portion **22** (that the clevis members **25** are not on) and extend outwards from the main portion, as shown in Figure 4. Each of the finger grip mounts **26** defines a threaded cylindrical opening **29** which is aligned with the threaded cylindrical opening defined by the other one of the finger grip mounts. The finger grip mounts **26** allow attachment of a pair of finger grips **30** on opposite sides of the main portion **22**.

Defined by the main portion **22** are a plurality of openings, including the guide opening **14** (as shown in Figure 4), three view ports **32**, a pair of restraining pin mounts **33** (as shown in Figure 5) and a pair of clamping arm guides **35** (as shown in Figure 6). Two of the view ports **32** are spaced on opposite sides of the finger grip mounts **26** and one of the view ports is positioned at the distal end of the main portion. The restraining pin mounts **33** are positioned adjacent the clevises **23** and are sized and shaped to receive restraining pins **34**.

The guide opening **14**, as shown best in Figure 4, has a cylindrical shape and extends in the proximal-distal direction from a proximal end of the body **11** to a distal end of the body. The diameter of the body guide opening **14** is the same for most of its length with the exception of a stepped drop to about half its major diameter immediately adjacent the distal end of the body **11** which is due to an inwardly directed retaining flange **57** of the body, as shown in Figure 14. The clamping arm guides **35** are elongated slots defined on opposite sides of the main portion **22** and are positioned between respective pairs of the clevis members **25** at the base of each clevis slot **27**, as shown in Figure 6. The clamping arm guides **35** are in communication with the distal portion of the guide opening **14** so as to allow passage therethrough of proximal ends of the clamping arms **19**.

The term "body" as used herein should be construed broadly to include any structure, or combination of structures, that provide movable support for at least one of the clamping surfaces **12** and defines one or more openings (e.g., opening **14**) through which the guide wire **15** can be extended. Movably supporting the clamping surfaces **12** refers to allowing, or facilitating movement in one or more degrees-of-freedom of at least one of the clamping surfaces so that they can be positioned relative

to each other in the open and closed positions. For instance, the body could define track openings having cam shapes that allow combined translation and rotation of the clamping arms **19** for movement of the clamping surfaces **12** between the open and closed positions.

As another example, the body could define multiple guide openings **14**, or differently shaped guide openings, and still fall within the purview of the present invention. Multiple guide openings could be used to directly or indirectly support multiple guide wires, or provide alternative position selections for the guide wires. Different sized and shaped guide openings can facilitate different sized and shaped guide wires. The terms "guide wire" and "guide pin" or "pin" are used interchangeably herein to denote a generally elongate, rigid member used as a fixed reference point for e.g. resurfacing of the femoral head **17**, as shown in Figure 7, or other portion of a patient's anatomy. Typically, that fixed reference point will be the central axis of the femoral head.

Each of the clamping arms **19** includes a first, proximal portion **38** and a second, distal portion **39**, as shown in Figures 1-3. The proximal portion **38** includes a plurality of pinion teeth **40** and defines a rotation shaft opening **41** and a restraining pin slot **43** positioned between the pinion teeth and the rotation shaft opening, as shown in Figures 8 and 9. The rotation shaft opening **41** is sized and shaped to receive a cylindrical arm shaft **42** which extends through the cylindrical opening **28** in each of a pair of adjacent clevis members **25** to rotatably support the clamping arm between the clevis members in the clevis slot **27**, as shown in Figures 1-3.

Each of the restraining pins **34** similarly extends through the aligned pair of restraining pin mounts **33** and the restraining pin slot **43** in the proximal portion **38** of a respective one of the clamping arms **19**. The restraining pin slot **43** allows sliding of the restraining pin therein while the clamping arm rotates about the arm shaft **42**. However, the ends of the restraining pin slot **43** serve as end points for the rotation about the arm shaft **42**.

The distal portion **39** of each of the clamping arms **19** extends distally and towards the distal portion of the other one of the clamping arms **19** when in the closed position, as shown in Figures 8 and 10. In particular, the distal portion **39** includes a distally directed first sub-portion **44** and second sub-portion **45** extending therefrom at a generally right angle thereto in the direction of the other one of the clamping arms

19. As shown in Figures 11 and 12, the second sub-portion **45** bifurcates into a pair of prongs **46** defining the respective one of the clamping surfaces **12** which abuts the femoral neck **16** in the closed position.

As shown in Figure 3, each of the clamping surfaces 12A, 12B are preferably sloped to form an oblique angle relative to the primary guide shaft 59, and more particularly to the axis of the guide opening 64 that passes through the primary guide shaft 59. The oblique angle is selected such that the clamping surfaces 12A, 12B orient the guide opening 64 slightly superior to the neutral axis of the femoral neck. This orientation causes the guide pin to enter the femoral head at a more vertical orientation than that of the natural neck. In turn, this allows the stem of a femoral head prosthesis to be implanted in a more vertical orientation, which distributes load more vertically and results in improved performance of the prosthesis. The axis of the femoral head prosthesis is preferably oriented about 5 degrees above the natural axis of the femoral neck. In order to achieve this orientation, the clamping surfaces 12A, 12B preferably have a slope of about five degrees relative to axis of the guide opening 64.

One of the clamping arms **19** has the optional feature of being adjustable independent of the coordinated movement of the pair of arms by the biasing assembly **18**. In this embodiment, the adjustable one of the clamping arms **19** is separated into its proximal and distal portions, **38** and **39**, respectively. The proximal portion has a widened distal sub-portion that defines an elongate opening **47** having a cylindrical shape that is open at the end opposite the pinion teeth **40**, as shown in Figure 13. Defined in the widened distal sub-portion is an elongate slot **48** that extends a majority of the length of the elongate opening **47** and is in communication therewith.

The first sub-portion **44** of the distal portion **39** of the adjustable one of the clamping arms **19** has its own widened cross-section and a cylindrical shape configured to be slidably mounted within the elongate opening **47** of the of the proximal portion **38**, as shown in Figure 2. The first sub-portion **44** also includes a pair of rounded, retaining protuberances **49** extending from opposite sides of the widened first sub-portion **44**. These protuberances **49** extend between the walls of the proximal portion **38** within the elongate opening **47**, so as to steady the distal portion **39** within the proximal portion **38**, but still allow sliding motion therebetween. Optionally, the protuberances **49** may be outwardly biased (e.g., "ball and spring"

members), but capable of being pressed against their bias into openings defined in the first sub-portion **44** under pressure. Use of ball and spring type members obviates the need to closely tolerance the size of the elongate opening **47** and the first potion **44**.

Relative sliding of the proximal and distal portions, **38** and **39**, of the adjustable one of the clamping arms **19** is restrained using a pin **50** that is sized to be slidably retained in the elongate slot **48** defined by the proximal portion **38**. In this manner, the range of sliding of the two portions **38, 39** is restrained and the two portions do not disassociate from each other at the end of their sliding range.

Advantageously, the sliding adjustability of the portions of the adjustable one of the clamping arms **19** allows the angle of the clamping surfaces **12** to be changed relative to each other. Changing of the relative angle of the clamping surfaces changes the orientation of the guide opening **14**, and hence the orientation of the guide opening **64**, with respect to the femur **13** which aids the surgeon in optimizing positioning of the femoral head prosthesis. It should be noted that adjustability may be achieved using other configurations. For instance, a rotatable hinge member could be employed between the two portions **38, 39**, or some type of multi-bar linkage. However, the illustrated embodiment has the advantage of an easily controlled adjustability due to the limitation of motion in a single sliding direction having fixed endpoints.

The biasing assembly **18** of the present invention provides biasing force to the clamping arms **19** so as to urge the clamping surfaces **12** together into the closed position abutting the femoral neck **16**. The biasing assembly **18** may also coordinate movement of the two clamping arms **19** so that they move between the open and closed positions simultaneously via one-handed operation.

In the illustrated embodiment, the biasing assembly is partially housed within the guide opening **14** of the body **11** and includes a rack member **51** and a coil spring **52**, as shown in Figure 14. The rack member **51** includes a threaded portion **53** that extends out of the body **11** and a portion bearing a plurality of rack teeth ("toothed portion") **54** that extends within the guide opening **14** of the body **11**, as shown in Figure 15. In addition, the rack member **51** defines its own guide opening **56** extending its entire axial length for allowing passage of the engagement member **20**. The toothed portion is flanked by an opposing pair of flanges **55** and the teeth thereon extend outwards from a central axis of the rack member **51** and are adjacently

positioned to extend between the pair of flanges. The threaded portion **53** extends from a side of one of the flanges **55** opposite the toothed portion **54** and includes threads extending around the outside of a cylindrical shaft.

When positioned within the guide opening **14** of the body **11**, the coil spring **52** is positioned between the retaining flange **57** of the body **11** which narrows the body guide opening **14** and the distal one of the flanges **55** of the rack member **51**. The rack member **51** is positioned adjacent the coil spring **52** at its distal end, a portion of which extends into the coil spring, and adjacent a retaining cap **58** at its opposite end, as shown in Figure 14.

Positioning of the coil spring **52** at the distal end of the rack member **51** causes it to exert an upward bias onto the distal one of the flanges **55**. This upward bias causes the toothed portion **54** to move upwards against the pinion teeth **40** of both of the clamping arms **19** which extend through the clamping arm guides **35** to mesh with the toothed portion. In turn, this upward bias causes coordinated movement distally and inwardly (due to rotation about the arm shaft **42**) toward the femoral neck **16** of the clamping surfaces **12** at the opposite ends of the clamping arms **19** from the pinion teeth.

The retaining cap **58** is affixed to the body **11** and extends within the proximal end of the guide opening **14** of the body **11** to abut the proximal one of the flanges **55** of the rack member **51** when the clamping arms **19** are in the closed position, as shown in Figure 1. In addition, the retaining cap **58** defines a central opening that is in communication with the guide opening **14** of the body **11** when secured to the body allowing passage therethrough of the engagement member **20**.

Together, the retaining flange **57** and the retaining cap **58** hold the biasing assembly **18** within the guide opening **14** of the body **11** and provide a limit for the movement of the rack member **51**, which in turn limits motion of the clamping arms **19**. Further limitation of the motion of the biasing assembly **18** is achieved by tightening the finger grips **30** in the threaded openings **29** of the finger grip mounts **29** so that the ends of the finger grips abut the sides of the rack member **51**. This also allows the user of the guide clamp **10** to lock the clamping arms **19** in place once the femoral neck **16** has been gripped by the clamping surfaces **12**.

Additional limitation in the movement of the biasing assembly **18** can be achieved through use of a locking knob **61** that includes a central, threaded opening

62, as shown in Figures 14 and 17. The central, threaded opening of the locking knob 61 allows it to be advanced along the threaded portion 53 of the rack member 51 until it abuts the retaining cap 58 positioned on the body 11. If the proximal one of the flanges 55 on the rack member 51 is abutting the opposite side of the retaining cap 58, the position of the locking knob 61 will lock biasing assembly 18 into its abutting position against the retaining cap, thereby locking the clamping arms 19 and clamping surfaces 12 into the closed position.

Alternatively, advancement of the locking knob 61 short of co-abutment of the retaining cap 58 with the proximal one of the flanges 55 further reduces the range of motion of the rack member 51 in the distal direction. This effectively limits the proximal and outwards range of motion of the clamping arms 19 and the space between the clamping surfaces 12 when in the open position. Proximal movement of the locking knob 61 along the threaded portion 53 of the rack member 51 is restrained using a knob retaining cap 63, as shown in Figures 14 and 16. The knob retaining cap has a threaded opening to allow it to be secured on the most proximal end of the threaded portion 53 of the rack member 51.

It should be noted that the biasing assembly 18 can include various different components as long as it biases the clamping surfaces 12 into the closed position about the femoral neck 16 and preferably also coordinates movement of the clamping surfaces. For instance, the biasing assembly could include leaf or coil springs incorporated in the clamping arms 19 to urge the clamping surfaces together 12. Notably, in such a configuration the biasing assembly is not necessarily contained within the body 11 of the guide clamp 10. However, the biasing assembly 18 of the illustrated embodiment being at least partially contained within the guide opening 14 of the body 11 has the advantages of limiting movement as described above.

In another aspect, the guide clamp 10 of the present invention may include the engagement member 20. The engagement member includes the primary guide shaft 59 and a textured tip 60. As shown in Figure 18, the primary guide shaft 59 of the illustrated embodiment is an elongate, cylindrical shaft defining the guide opening 64 extending its entire length. Unlike the previously described guide openings, the guide opening 64 of the primary guide shaft 59 is in direct contact with the guide wire 15 as it extends through the guide clamp 10. The primary guide shaft 59 includes a

retaining ring **65** fixed to its proximal end and a threaded portion **66** at its distal end having a reduced diameter.

The textured tip **60** of the illustrated embodiment also has a cylindrical shape and the distal end of the textured tip **60** has a plurality of serrations that provide a textured gripping surface for abutting the femoral head **17**, as shown in Figure 1. In addition, the textured tip **60** defines a threaded opening **67** (as shown in Figure 19) that is sized to mate with the threaded portion **66** at the distal end of the primary guide shaft **59**, allowing the textured tip to be secured thereto. The term "textured" as used herein denotes any type of surface or pattern that facilitates a non-slip abutment with the femoral head **17**, such as crenellations, cross-hatching or the illustrated serrations. Non-slip abutment with the femoral head is preferable so as to assure a proper and more accurate path for the guide wire along the selected reference line/point.

Threaded attachment facilitates assembly of the guide clamp **10** by allowing the primary guide shaft **64** to be inserted through the opening of the retaining cap **58**, the guide opening **56** of the rack member **51**, the coil spring **52** and the opening in the retaining flange **57** of the body **11** until its distal end extends out of the body. The threaded opening **67** of the textured tip **60** is then secured on the threaded portion **66** of the primary guide shaft **59**.

The various openings through which the primary guide shaft **59** extends are sized to allow sliding of the engagement member **20** so that it can be advanced and retracted from abutting contact with the femoral head **17**. Advancement and retraction is limited by the retaining ring **65** at the proximal end of the engagement member **20** and the textured tip **60** at the distal end of the engagement member. While it is possible to provide a means for locking the engagement member adjacent the femoral head, such will typically not be necessary. The friction forces between the engagement member and the guide shaft and the non-slip abutment are typically enough to prevent unwanted movement of the engagement member.

It should be noted that the engagement member **20** of the present invention need not be limited to the illustrated embodiment and can include any member, or combination of members (such as an arm that swings distally to contact the femoral head **17**), that are capable of providing a moveable third surface for engagement with the femur **13** in addition the to clamping surfaces **12**. Preferably, the engagement

member **20** also further provides an extended guide opening that is capable of guiding insertion of the guide wire **15** right up to the surface of the femoral head **17**.

Having described the structure of guide clamp 10, we will now describe its use.

During use, the user grasps body 11 in between, e.g., the user's first and middle finger, with the first and middle finger gripping finger grips 26 and locking knob **61** of the guide clamp **10** to be manipulated by the thumb of the same hand. The locking knob **61** is then pushed into the body **11** by the thumb, which moves the rack member **51** against the bias of the coil spring **52**. The teeth of the toothed portion **54** cause the pinion teeth **40** at the proximal portion **38** of the clamping arms **19** to rotate distally about the arm shafts **42**, causing the distal portion **39** of the clamping arms, and the clamping surfaces **12** supported thereby, to move proximally and outwardly away from each other into an open position. At this point, the femur **13**, and in particular the femoral neck **16**, is inserted in between the pair of clamping surfaces **12**.

Once the femoral neck **16** has been positioned the locking knob **61** is released allowing the toothed portion **54** to be urged proximally by the coil spring **52**. Such urging causes the toothed portion **54** and pinion teeth **40** to interact and rotate the proximal portion **38** of each of the clamping arms **19** proximally about the arm shafts **42**. In turn, the distal portion **39** of the clamping arms **19**, and the clamping surfaces **12** supported thereby, rotate about the arm shafts **42** distally and towards each other to close about the femoral neck **16**. Once in the closed position, the locking knob **61** can be advanced on the threaded portion **53** until it abuts the retaining cap **58** and holds the proximal one of the flanges **55** against the other side of the retaining cap. This effectively locks the guiding clamp **10** into position on the femur **13**. Thus, what was originally a two-handed operation has now been reduced to a one-handed operation.

Adjustments to the angle of the guide opening **64** of the primary guide shaft **59** with respect to the femoral head **17** can be made by adjusting the adjustable one of the clamping arms **19**. For instance, the distal portion **39** of the clamping arm can be slid within the elongate opening **47** defined by the proximal portion **38** until a desired change in angle is achieved.

Once the clamping surfaces **12** have been secured in the closed position, the primary guide shaft **59** of the engagement member **20** is advanced within the guide opening **56** of the rack member **51**, and other openings, until the textured tip **60** abuts

the femoral head **17**. In this manner, the guide opening **64** of the primary guide shaft **59** extends right up to the surface of the femoral head **17**. The guide wire **15** is then inserted into guide opening **64** defined at the retaining ring **65** of the engagement member, and is advanced through the rest of the guide opening **64** of the primary guide shaft **59** until it intersects the femoral head **17**. The guide wire **15** is then driven into the femoral head **17** using a hammer, drill or other device known in the art.

Once the pin has been secured, the guide clamp **10** is removed by loosening the locking knob **61** and repeating the steps described above for moving the clamping surfaces **12** to the open position. After removal of the guide clamp **10**, the guide wire **15** is used as a guide for cutting the femoral head **17** using a cannulated drill and bit, as shown in Figure 7.

The present invention has many advantages. For example, coordinated, biased closing movement of the clamping surfaces **12** using the biasing assembly **18** allowing for one-handed operation. Such coordinated, biased closing movement ensures that the clamping arms **19** and their clamping surfaces **12** center the femoral neck **16** between them for proper alignment of the various guide openings with the femoral head **17**. The adjustability of one, or more, of the clamping arms **19** allows for modifications of the angle at which the various guide openings, and hence the angle of the guide wire **15**, will be positioned with respect to the femoral head **17**. The engagement member **20** bridges the gap between the body **11** of the guiding clamp **10** and the femoral head **17** by providing additional guide opening length up to the femoral head. This improves the accuracy of placement of the guide wire **15**. In addition, the textured tip **60** of the engagement member increases the security of the grip that the guiding clamp **10** has on the femur **13**.

Many modifications and other embodiments of the inventions set forth herein will come to mind to one skilled in the art to which these inventions pertain having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is to be understood that the inventions are not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

CLAIMS

What is claimed is:

1. A guide clamp for clamping of a femur having a head and a neck, and guiding placement of a guide wire relative to the femur, said guide clamp comprising:

at least two clamping surfaces configured to move between an open position and a closed position, wherein said clamping surfaces are sufficiently spaced apart in the open position to allow insertion of the femur therebetween and wherein said clamping surfaces generally oppose each other and are sufficiently close together in the closed position to firmly hold the femur therebetween;

a body supporting the clamping surfaces and configured to allow movement of the clamping surfaces relative to each other, said body defining a guide opening configured to receive and allow passage of the guide wire therethrough to the femur; and

a spring biasing assembly configured to bias the clamping surfaces into the closed position about the femur wherein the clamping surfaces secure the body relative to the femur so that the guide wire is secured relative to the femur when extending through the guide opening defined by the body.

2. A guide clamp of Claim 1, further comprising a pair of clamping arms, wherein each of said clamping arms includes one of the clamping surfaces.

3. A guide clamp of Claim 2, wherein the spring biasing assembly is configured to bias both of the clamping arms and coordinate movement of the clamping surfaces between the open and closed positions.

4. A guide clamp of Claim 2, wherein both of the clamping arms are rotatably supported by the body and wherein the spring biasing assembly is operably engaged with both of the clamping arms so as to bias the clamping arms into the closed position.

5. A guide clamp of Claim 4, wherein each of the clamping arms includes a plurality of pinion teeth and wherein the spring biasing assembly includes a biased

rack with a plurality of rack teeth configured to engage the pinion teeth of the clamping arms so that movement of the rack causes rotation of the clamping arms and relative movement of the clamping surfaces.

6. A guide clamp of Claim 5, wherein the biasing assembly includes a coil spring extending around the biased rack and biasing the rack to move the clamping surfaces of the clamping arms into the closed position.

7. A guide clamp of Claim 4, wherein the spring biasing assembly includes a translation member and spring, wherein said translation member is configured for linear translation with respect to the body and includes engagement elements configured to engage each of the clamping arms and wherein said spring is configured to linearly bias the translation member with respect to the body.

8. A guide clamp of Claim 7, wherein the spring is a coil spring including a first end abutting the body and a second end abutting the translation member.

9. A guide clamp of Claim 8, wherein the coil spring extends about the translation member and wherein the translation member defines a guide opening extending within the guide opening of the body.

10. A guide clamp of Claim 2, wherein the clamping surface of one of the clamping arms is configured for adjustable positioning.

11. A guide clamp of Claim 1, further comprising an engagement member supported by the body and extending therefrom into abutting contact with the head of the femur when secured between the clamping surfaces.

12. A guide clamp of Claim 11, wherein the engagement member defines a guide opening aligned with the guide opening defined in the body and allowing passage of the guide wire through both of the guide openings to the head of the femur.

13. A guide clamp of Claim 12, wherein the engagement member is movably supported by the body allowing the engagement member to be retracted from, and extended into, abutting contact with the head of the femur.

14. A guide clamp of Claim 13, wherein the engagement member is slidably supported by the body along the axis of the guide opening defined by the body allowing the engagement member to be retracted from, and extended into, abutting contact with the head of the femur.

15. A guide clamp of Claim 14, wherein the engagement member includes a textured femur-adjacent end.

16. A guide clamp of Claim 15, wherein the textured femur-adjacent end includes serrations.

17. A guide clamp for clamping of a femur and guiding placement of a guide wire relative to the femur, said guide clamp comprising:

at least two clamping surfaces configured to move between an open position and a closed position, wherein said clamping surfaces are sufficiently spaced apart in the open position to allow insertion of the femur therebetween and wherein said clamping surfaces generally oppose each other and are sufficiently close together in the closed position to firmly hold the femur therebetween;

a body supporting the clamping surfaces and configured to allow movement of the clamping surfaces relative to each other, said body defining a guide opening configured to receive and allow passage of the guide wire therethrough to the femur; and

an engagement member supported by the body and which is configured to extend therefrom into abutting contact with the head of the femur when the contact surfaces are in the closed position and the clamping surfaces secure the femur.

18. A guide clamp of Claim 17, wherein the engagement member defines a guide opening aligned with the guide opening defined in the body and allowing passage of the guide wire through both of the guide openings to the head of the femur.

19. A guide clamp of Claim 18, wherein the engagement member is movably supported by the body allowing the engagement member to be retracted from, and extended into, abutting contact with the head of the femur.

20. A guide clamp of Claim 18, wherein the engagement member is slidably supported by the body, allowing the engagement member to be retracted from, and extended into, abutting contact with the head of the femur.

21. A guide clamp of Claim 20, wherein the engagement member includes a textured femur-adjacent end.

22. A guide clamp of Claim 21, wherein the textured femur-adjacent end includes serrations.

23. A guide clamp of Claim 20, further comprising a pair of clamping arms, wherein each of said clamping arms includes one of the clamping surfaces.

24. A guide clamp of Claim 23, wherein the clamping surfaces are configured to extend around the neck of the femur when adjacent to each other in the closed position.

25. A method of clamping a femur to facilitate insertion of a guide wire into the femur, said method comprising:

separating at least two opposing clamping surfaces of a guide clamp against a spring bias by moving the clamping surfaces relative to a body that supports the opposing clamping surfaces;

inserting a femur between the clamping surfaces;

closing the pair of opposing clamping surfaces onto the femur by allowing the clamping surfaces to move with the spring bias relative to the body so as to secure the femur between the clamping surfaces; and

inserting a guide wire through a guide wire opening defined by the body and advancing the guide wire into contact with the femur, wherein the guide wire is supported by the body and clamping surfaces relative to the femur.

26. A method of clamping of Claim 25, further comprising advancing an engagement member supported by the body into abutting contact with a head of the femur after closing the clamping surfaces.

27. A method of clamping of Claim 26, wherein inserting the guide wire includes advancing the guide wire through a guide wire opening defined in the engagement member, wherein said guide wire openings of the body and engagement member are generally aligned.

FIGURE 1

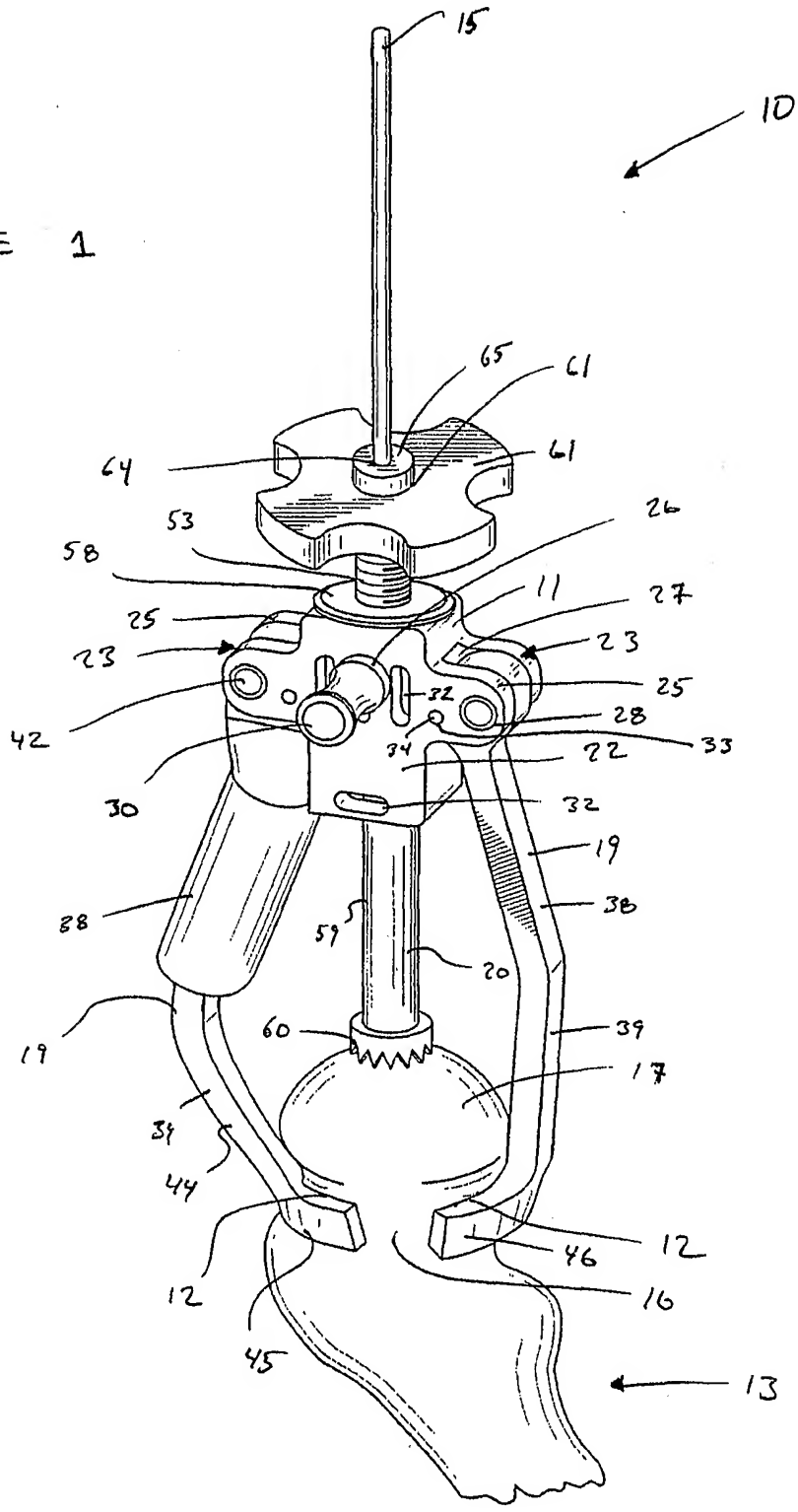
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FIGURE 1A

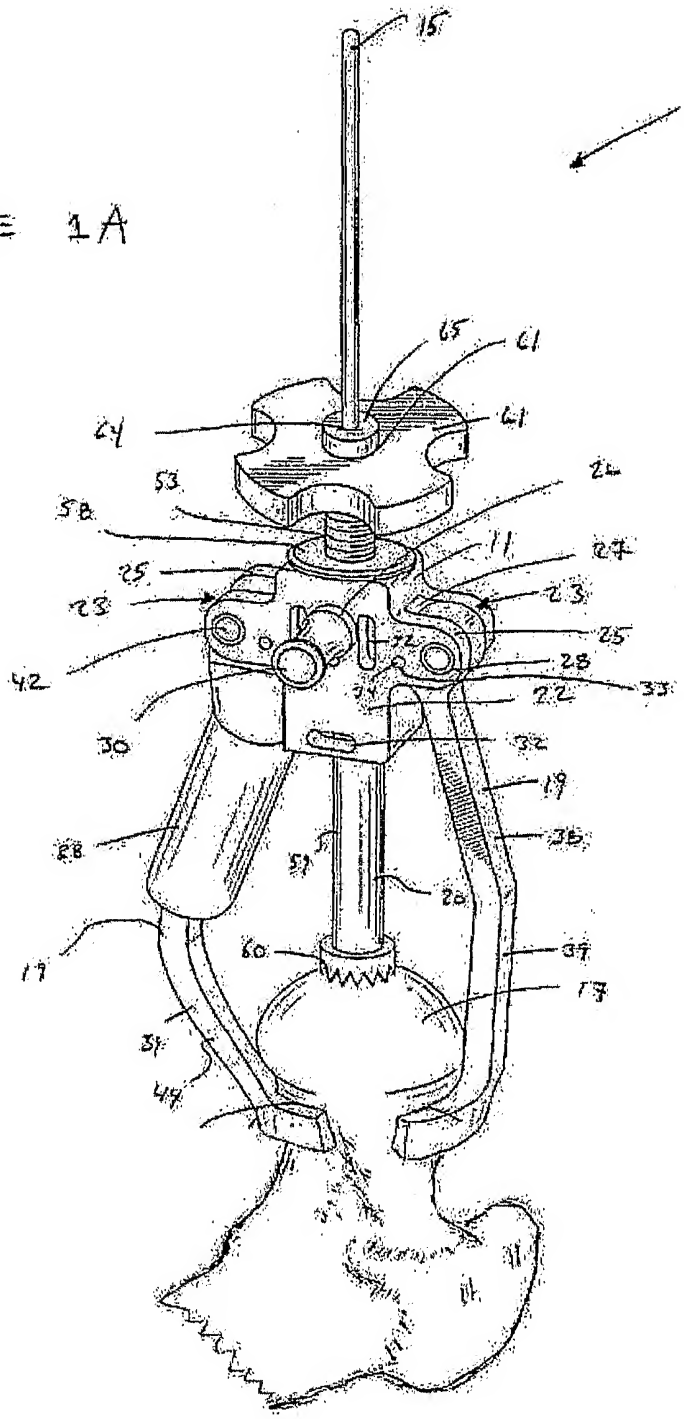
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FIGURE 2

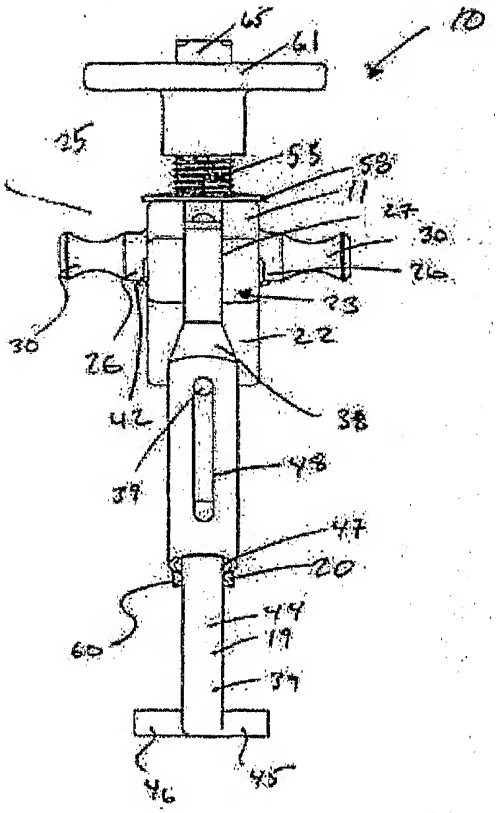


FIGURE 3

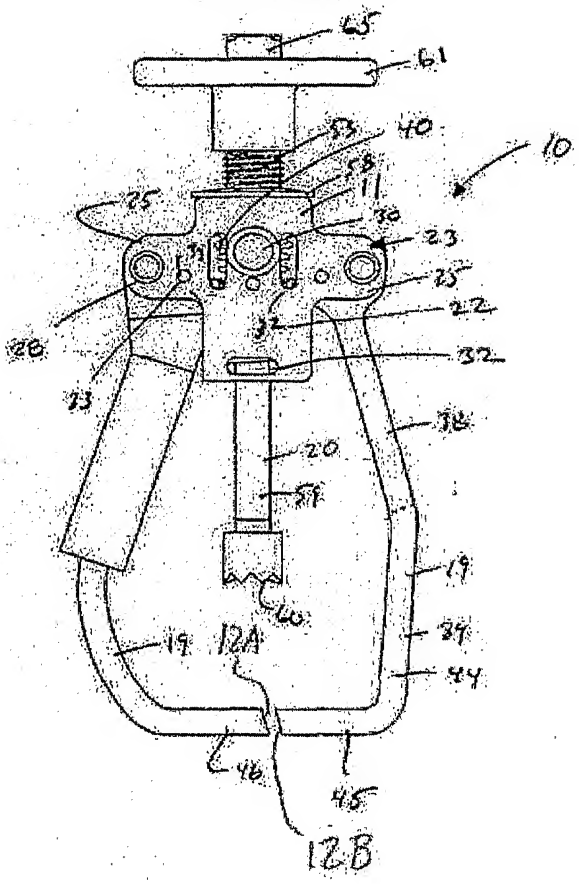


FIGURE 4

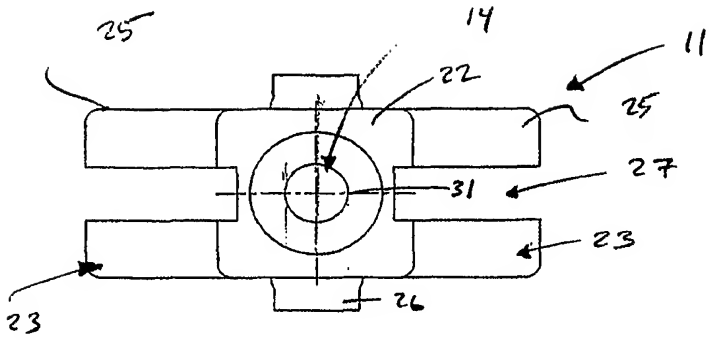


FIGURE 5

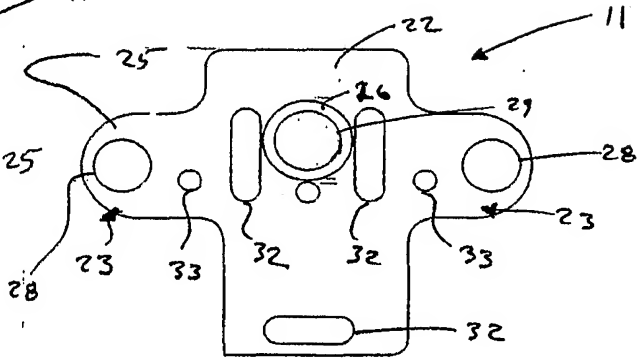
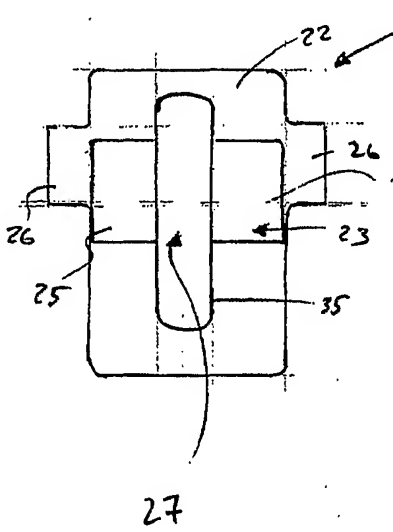


FIGURE 6



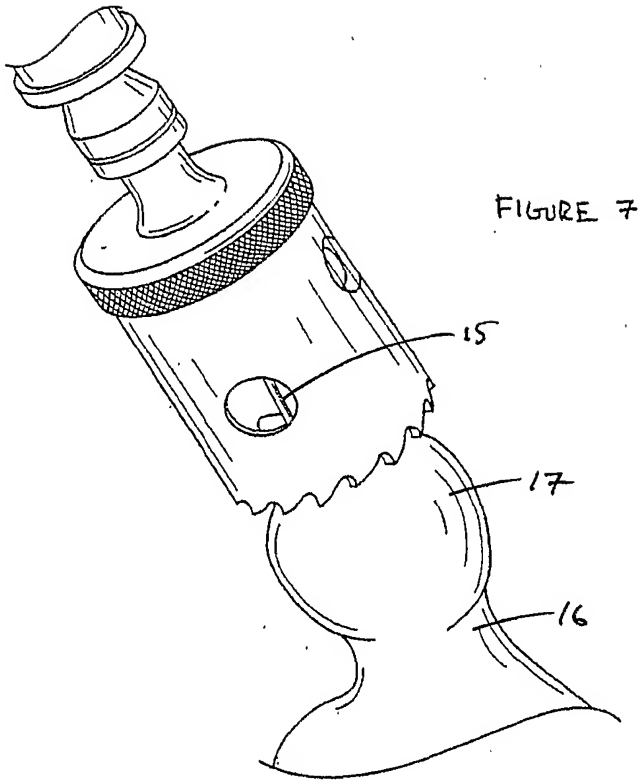


FIGURE 7

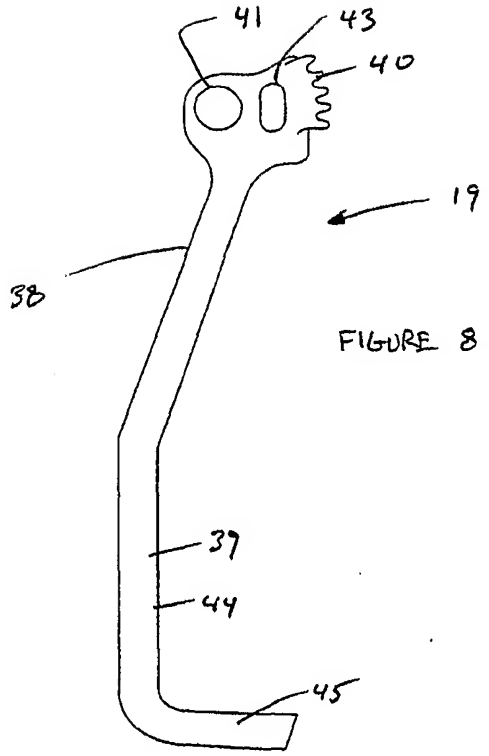


FIGURE 8

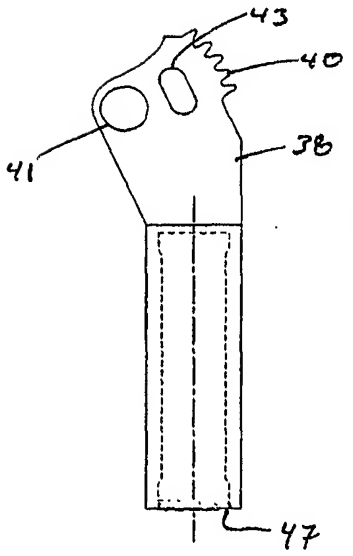


FIGURE 9

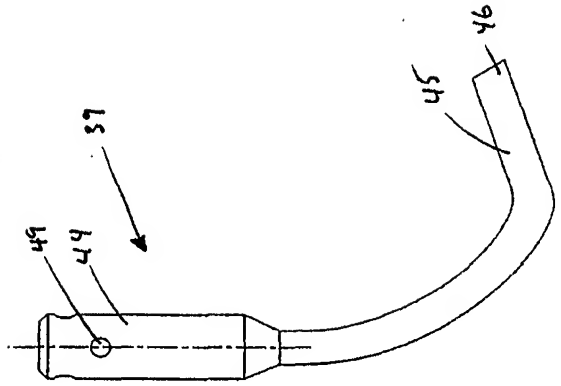


FIGURE 10

FIGURE 11

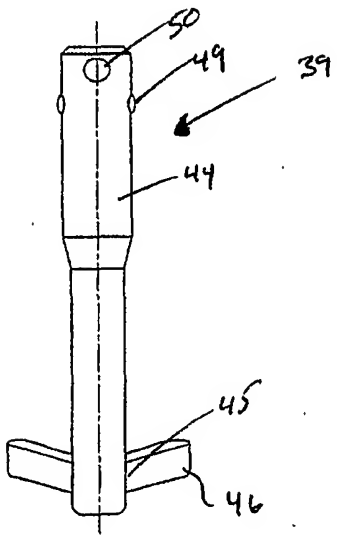
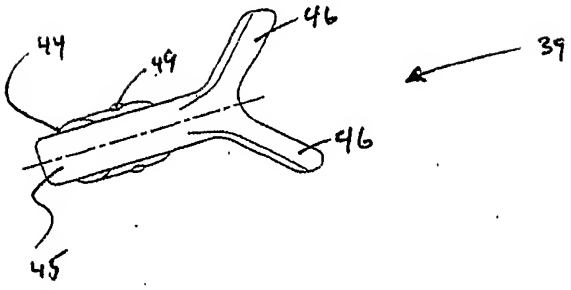


FIGURE 12



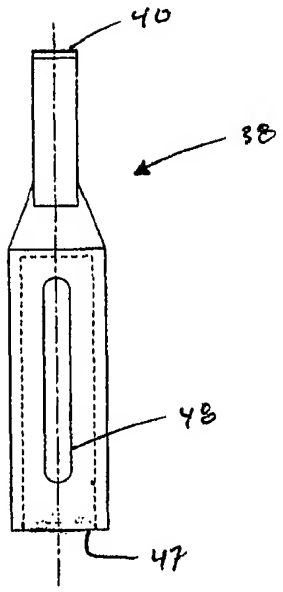


FIGURE 13

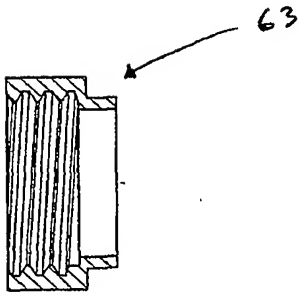


FIGURE 16

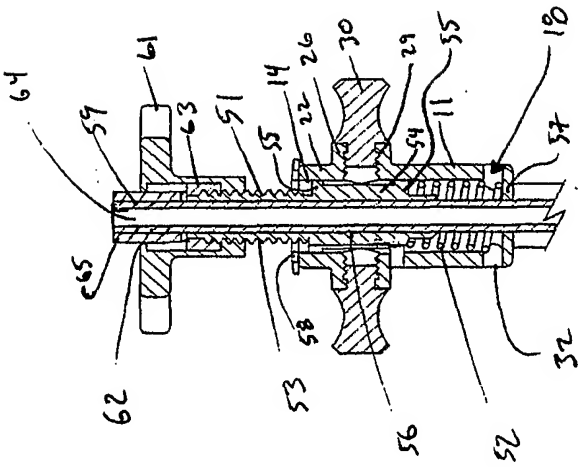


FIGURE 14

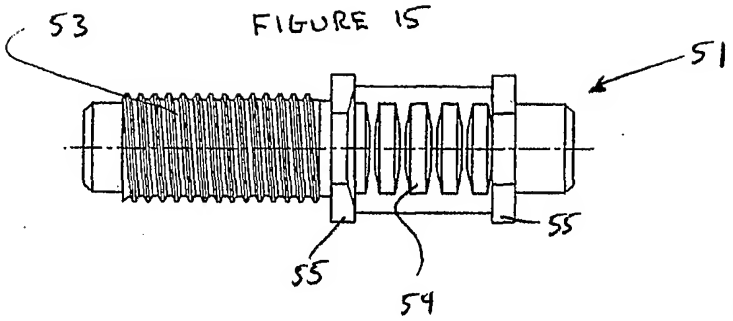


FIGURE 15

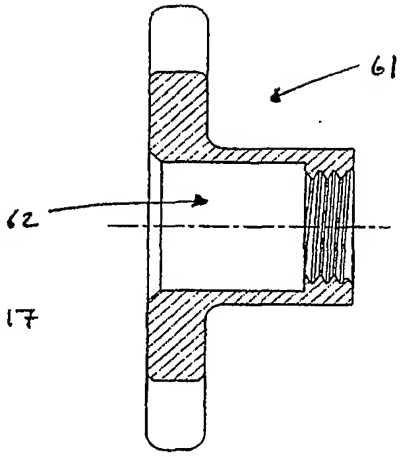


FIGURE 17

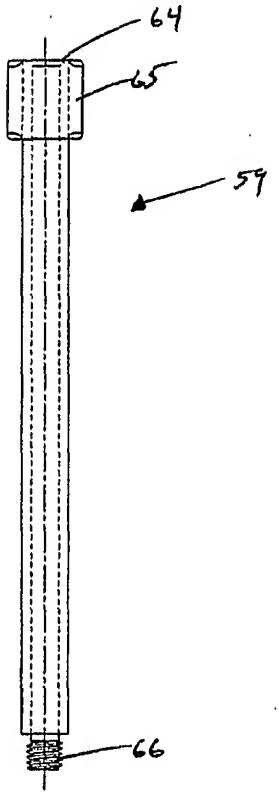


FIGURE 18

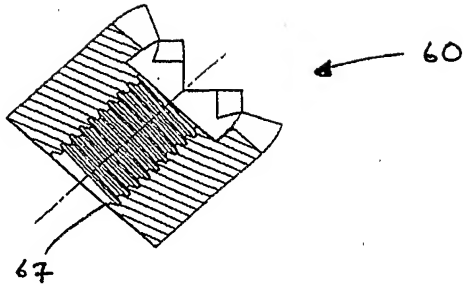


FIGURE 19

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US2004/038931

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A61B17/17

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 4 896 663 A (VANDEWALLS ET AL) 30 January 1990 (1990-01-30) column 2, line 45 - column 4, line 66 figures	17-24 1-8, 11-16
Y A	DE 100 13 331 A1 (BIOMET MERCK DEUTSCHLAND GMBH) 20 September 2001 (2001-09-20) column 4, line 9 - column 6, line 43 figures	1-8, 11-16 17-24
X A	US 5 817 098 A (ALBREKTSSON ET AL) 6 October 1998 (1998-10-06) column 5, line 23 - column 6, line 67 figures 2-4	17-24 1-16

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
14 March 2005	23/03/2005

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Nistor, L

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Form PCT/ISA/210 (second sheet) (January 2004)

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6 156 069 A (AMSTUTZ ET AL) 5 December 2000 (2000-12-05) cited in the application column 5, line 45 - line 56 figure 9	1-24
A	US 86 016 A (HOWEL SILAS J.) 19 January 1869 (1869-01-19) the whole document	1-16
A	US 2 416 228 A (SHEPPARD NELSON H) 18 February 1947 (1947-02-18) column 3, line 3 - column 5, line 19 figures	1-16
A	US 1 727 061 A (HICKS ROBERT J. F) 3 September 1929 (1929-09-03) page 1, line 71 - page 2, line 127 figures 1,2,4,5	1-16
A	DE 11 64 019 B (CHIRON-WERKE G.M.B.H) 27 February 1964 (1964-02-27) column 4, line 38 - column 5, line 3 figure 7	17-24
A	PATENT ABSTRACTS OF JAPAN vol. 1997, no. 07, 31 July 1997 (1997-07-31) & JP 09 075366 A (M II SYST:KK), 25 March 1997 (1997-03-25) abstract; figures 3,8	1,15-17, 21,22

INTERNATIONAL SEARCH REPORT

national application No.
PCT/US2004/038931

Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. [X] Claims Nos.: 25-27
because they relate to subject matter not required to be searched by this Authority, namely:

Rule 39.1(iv) PCT - Method for treatment of the human or animal body by surgery

2. [ ] Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. [ ] Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. [ ] As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. [X] As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. [ ] As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. [ ] No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

[ ] The additional search fees were accompanied by the applicant's protest.

[ ] No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-16

guide clamp comprising at least two clamping surfaces, a body and a spring biasing assembly..

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2. claims: 17-24

guide clamp comrpisng at least two clamping surfaces, a body and an engagement member.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US2004/038931

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4896663 A	30-01-1990	NONE	
DE 10013331 A1	20-09-2001	NONE	
US 5817098 A	06-10-1998	AT 257672 T	15-01-2004
		AU 693697 B2	02-07-1998
		AU 5783196 A	29-11-1996
		BR 9608821 A	15-06-1999
		CA 2219116 A1	21-11-1996
		CN 1184410 A ,C	10-06-1998
		CZ 9703623 A3	17-06-1998
		DE 69631344 D1	19-02-2004
		DE 69631344 T2	02-12-2004
		DK 957782 T3	17-05-2004
		EP 0957782 A1	24-11-1999
		ES 2213773 T3	01-09-2004
		HU 9900303 A2	28-05-1999
		JP 3307399 B2	24-07-2002
		JP 11500045 T	06-01-1999
		KR 267823 B1	01-11-2000
		NO 975173 A	11-11-1997
		NZ 308248 A	27-05-1998
		PL 323351 A1	30-03-1998
		PT 957782 T	31-05-2004
		RU 2157665 C2	20-10-2000
		WO 9636285 A1	21-11-1996
		TR 9701374 T1	21-02-1998
US 6156069 A	05-12-2000	NONE	
US 86016 A		NONE	
US 2416228 A	18-02-1947	NONE	
US 1727061 A	03-09-1929	NONE	
DE 1164019 B	27-02-1964	NONE	
JP 09075366 A	25-03-1997	NONE	